REMARKS

Summary of Amendments

1. Claims 1 through 16 were originally presented in this application. Claims 17 through 20 were added by an amendment dated November 1, 2004, in response to a first non-final Office action. Claims 3 and 7 were canceled without prejudice by an amendment dated March 30, 2005, in response to a second non-final Office action. Claims 1, 9, 11, and 15 were canceled without prejudice in a Request for Continued Examination filed on December 5, 2005.

2. Claims 21, 22, and 23 have been added in this paper. No additional claims have been canceled. Claims 2, 4, 17, and 18 have been amended, as described in more detail below, to more particularly point out and distinctly claim the inventive material of the instant invention. Claims 2, 4-6, 8, 10, 12-14, and 16-23 remain pending.

Claim Rejections - 35 U.S.C. § 102

3. Claims 5, 6, and 8 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Pat. No. 5,543,210 to Kullander et al. In particular, the Examiner states: "Kullander et al. discloses the claimed diamond coating on a cemented carbide with the claimed cobalt content having the claimed surface roughness. The stress is considered inherent."

4. Applicants respectfully traverse the rejection to independent claim 5 for the reasons set forth below. First, Applicants disagree with the Examiner that the recited compressive stress ("a compressive residual stress of 0.1 GPa or more and 8 GPa or less") is inherent in the prior art. Kullander et al. teach a structure in which a diamond layer is over-coated with a CrN layer (layer *A* in the scanning electron micrograph). The purpose of this CrN layer is to improve the flaking resistance and wear resistance of the diamond layer (column 2, lines 40-56). In other words, the CrN layer is deposited over the diamond layer in order to retard delamination of the diamond layer from the cemented carbide tool body. If the compressive stress of the diamond layer disclosed by Kullander et al. was in the range recited in claim 5 (0.1 to 8 GPa), then the disclosed diamond layer would likely not delaminate and the CrN layer (which is the essence of the Kullander et al invention) would not be necessary.

5. As described in paragraph [0034] of Applicant's original specification, films having a compressive stress of greater than 8 GPa are prone to peeling:

> In the present embodiment, a residual stress is imparted so as to be a compressive pressure of 0.1 GPa or more, 8 GPa or less on the compound thin films and hard carbon thin films. Imparting a compressive residual stress on the cemented-carbide base material remarkably remedies the breakage tendency of router cutters and drills. Herein, if the compressive residual stress is 0.1 GPa or less, there is no noticeable improvement in fracturing resistance, and if 8 GPa or more, owing to the film's stress rating being high, *the film becomes prone to peeling off*.

(Emphasis added.) Furthermore, in the examples presented by Kullander et al., the diamond layer thickness is in the range from 5 to 10 μm. It is well known to those of ordinary skill in the art that diamond films of such thickness have compressive stresses greater than the range recited in claim 5. For example, paragraph [0033] of Applicants' original specification states: "at film thicknesses . . . in excess of 3 μm there were problems in that *internal stress accumulating in the coating would grow large*, making it prone to peeling off and producing chips in the coating." (Emphasis added.) Hence, it is clear that the diamond layer disclosed by Kullander et al. has a compressive stress of greater than 8 GPa. Again, this is the reason for the CrN layer taught by Kullander et al.

6. The Examiner also asserts that Kullander et al. teach a cemented tungsten carbide having the claimed cobalt content (4-12%). While Examples 1, 3, 4, 5, 6, and 7 of Kullander et al. do teach tungsten carbide substrates having either 4 or 6% cobalt, they also teach that the substrates have a "cobalt depleted surface zone" (column 4, lines 9 and 47, column 5, lines 3, 28, and 53, and column 6, line 4). Since the substrates have bulk cobalt concentrations of either 4 or 6%, the depleted surfaces (upon which the diamond films are deposited) must have cobalt concentrations less than the claimed range of 4-12%. While Kullander et al. do not state the reason for their use of a "cobalt depleted surface zone," it is presumably to prevent cracking of the diamond layer due to thermal expansion mismatch between the substrate and the film (see the introduction section of U.S. Pat. No. 6,007,909, which is of record in this case). Advantageously, no such "cobalt depleted zone" is used or required in the instant invention.

7. It is therefore respectfully submitted that independent claim 5 should be held allowable for the reasons set forth above in paragraphs 4, 5, and 6. It follows that dependent claims 6, 8, 13, 14, and 16 must also be allowable, since these dependent claims carry with them all the elements of independent claim 5 to which they ultimately refer.

8. Applicants present new dependent claims 22 and 23 for further consideration. Both claims are supported by the original application, such that no new matter is entered and no new search should be required. Support for claim 22 recitation of

"a substantially uniform distribution of tungsten carbide and cobalt" is inherent from the specification, in that there is no disclosure of cobalt-depleted zones anywhere in the specification. Support for claim 23 is found, for example, in Examples 13 and 26 of Tables I and II, in which the hard carbon film thicknesses are 0.1 and 0.18 μm, respectively.

9. New claims 22 and 23 both depend directly from independent claim 5. Applicants therefore submit that new claims 22 and 23 are allowable for the same reasons as set forth above in paragraphs 4, 5, and 6 concerning independent claim 5. Moreover, Applicants submit that new claim 22 is further patentably distinct from Kullander et al. in that claim 22 explicitly recites a cemented carbide base material having a uniform distribution of tungsten carbide and cobalt. This is in clear distinction to the "cobalt depleted surface zone" disclosed by Kullander et al. Applicants also submit that new claim 23 is further patentably distinct from Kullander et al. in that claim 23 recites a hard carbon film thickness of less than 1 μm. Kullander et al. explicitly recites a diamond film having a thickness in the range from 1 to 20 μm, and a preferred thickness in the range from 4-15 μm.

Claim Rejections - 35 U.S.C. § 103

10. Claims 13, 14, 16, 19, and 20 stand rejected under U.S.C. § 103(a) as being unpatentable over Kullander et al. in view of U.S. Pat. No. 6,288,139 to Oskarsson. Applicants respectfully submit that this rejection is moot in view of the remarks above in paragraphs 4, 5, and 6. In particular, claims 13, 14, and 16 depend from independent claim 5 and are believed to be allowable for the same reasons that claim 5 is. Independent claims 19 and 20 are similar to independent claim 5 in that they recite the same compressive stress range and the same substrate cobalt content. Thus, claims 19 and 20 are also believed to be patentable for the same reasons as independent claim 5 is.

11. Claims 2, 4, 10, 12, 17, and 18 stand rejected under U.S.C. § 103(a) as being unpatentable over U.S. Pat. No. 6,565,957 to Nakamura et al in view of U.S. Pat. No. 4,966,501 to Nomura et al. In particular, the Examiner states:

> Nakamura et al. discloses the claimed metal compound coating with the claimed stress on the claimed cemented carbide. Nakamura et al. does not explicitly disclose the surface roughness of the coating. Nomura et al. discloses the claimed surface roughness of metal compound coating on tools. Thus it would have been obvious to one of ordinary skill in the art to provide Nakamura et al. with the claimed surface roughness, as this roughness is known to improve the performance of coated tools as shown by Nomura et al.

12. Applicant respectfully traverses this rejection to the extent that it is pertinent to independent claims 4, 17, and 18, as amended in this paper. Claims 4, 17, and 18 have been amended to recite: "wherein said compound thin film has an as-deposited surface roughness of 0.01 μm or more and less than 0.3 μm by indication Ra." Applicant respectfully submits that these amendments are supported by Paragraph [0032], as well as by Tables I and II of the original specification, such that no new matter has been entered and no new search should be required. In particular, the recitation: "said compound thin film has an as-deposited surface roughness" is supported by Paragraph [0032], which states: "Compound thin films and hard carbon thin films *deposited as by the present embodiment are formed such that the surface roughness thereof*, by JIS-code indication Ra, will be 0.01 μm or more, 0.5 μm or less." (Emphasis added.) The new range of surface roughness values is supported by Exemplary Embodiments 1-7 and 9-12 in Table I and Exemplary Embodiments 14-20 and 22-25 in Table II of the original specification.

13. Applicant respectfully submits that independent claims 4, 17, and 18, as amended, now distinguish patentably over Nakamura et al. in view of Nomura et al. There is nothing in either of the cited references that teaches or suggests a machining tool with a compound film having an as-deposited surface roughness in the range of 0.01 or more and less than 0.3 μm Ra. On the contrary, Nomura et al. teaches compound films having an as-deposited surface roughness of values of 0.3 μm or greater (samples A, B, C, D, and E in Table 1). In order to achieve surface roughness values of less than 0.3 μm Ra (as recited in amended claim 4), Nomura et al. specifically teaches polishing (or lapping) the compound thin films (samples F, G, H, I, and J in Table 1 and column 5, lines 49-56). It is clear then that Nomura et al. do not disclose a compound film having an as-deposited surface roughness of less than 0.3 μm.

14. Moreover, it may be fairly said that Nomura et al. teach away from a compound film having an as-deposited surface roughness of less than 0.3 μm. The teaching away is both implicit and explicit. It is implicit in that the disclosed lapping process adds a process step to fabrication, which disadvantageously increases both the time and expense to produce a cutting tool. If it were possible, surely Nomura et al. would have avoided this additional lapping step. The teaching away is explicit, for example, beginning at column 2, line 65, which states:

> The most simple method for obtaining both a relatively thick coating layer from the viewpoint of the near resistance[,] and a smooth surface of a coating layer from the viewpoint of preventing the coating film from a localized damage[,] consists in *subjecting the surface of the coating layer of a tool*, including at least a cutting edge, *to mechanical polishing after coating* and thus improving the surface roughness.

(Emphasis added.)

15. It is respectfully submitted that independent claims 4, 17, and 18, as amended, should be held allowable for the reasons set forth above in paragraphs 12, 13, and 14. It follows that dependent claims 2, 10, and 12 must also be allowable, since these dependent claims carry with them all the elements of independent claim 4 to which they ultimately refer.

16. Applicants respectfully submit that dependent claim 2, as amended, is further patentably distinct from the combination of references cited by the Examiner. Claim 2 has been amended to recite that a "predetermined thickness of said compound thin film is 0.05 μm or more and less than 2 μm." This amendment is supported by Exemplary Embodiments 1-7, 11-12, 14-20, and 24-25 in Tables I and II, such that no new matter has been entered and no new search should be required. Nomura et al. clearly teaches away from such a construction at column 3, lines 23-25, which states: "if the thickness is less than 2 μm, the wear resistance [of] the coating is not sufficient." Moreover, Nomura et al. further teach away from a thickness of less than 2 μm by their examples. Table 1 shows two- and three-layer coatings having cumulative thicknesses ranging from 7 to 8.5 μm (nearly *four times* that of the limitation recited in claim 2). Accordingly, Applicants submit that claim 2, as amended, is further allowable over the prior art of record.

17. Applicants present new dependent claim 21 for further consideration. New claim 21 is supported by the original specification (e.g., Tables 1 and 2), such that no new matter has been entered and no new search should be required. New claim 21 depends directly from independent claim 4. Applicants therefore submit that new claim 21 is allowable for the same reasons as independent claim 4 is, as set forth above. Moreover, Applicant submits that claim 21 is further patentably distinct from the prior art of record in that it recites a compound thin film "consisting of only a single layer." Both Nakamura et al. and Nomura et al. teach multi-layer compound thin films. Nakamura et al. teach compound thin films having at least two layers. Nomura et al., as described above, teach two- and three-layer coatings.

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Accordingly, Applicant courteously urges that this application is in condition for allowance. Reconsideration and withdrawal of the rejections is requested. Favorable action by the Examiner at an early date is solicited.

Respectfully submitted,

June 23, 2006

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